DEVELOPING HIGH-YIELDING LINES OF TOMATO (*Lycopersicon esculentum* Mill) BY SELECTION

Ahmed M. Kansouh

Vegt. Res. Dept., Hort. Res. Inst., Agric. Res. Cent., Giza, Egypt

ABSTRACT

From 3 F_2 populations, promising 24 lines (F_6) of tomato were chosen and evaluated during summer successive seasons of 1997-2001 at Kafr-Farses, Zifta district, Gharbia governorate, Middle-Delta Region. Estimates of coefficient of variance (C.V.%) values showed that, most of the breeding lines were highly homogeneous and could be considered pure lines.

Highly significant differences were found among the lines in all studied traits. The lines S-15, S-65, S-102 and S-106 were vigorous growth characters, i.e., plant height, main stem length, number of branches and number of leaves. The line RIG-10 produced the highest early yield/plant (1.9 kg). In the best 5 lines, total yields surpassed by > 60% the check cvs. (CastleRock, Super strain B and Peto 86). Most of the breeding lines produced heavier fruits than the check cvs. The non-ripening mutation (nor) was observed in the lines G4-2, G-19, G-30 and GR2-4, which produced the firmest fruits. The line S.106 have the highest T.S.S. (%) in their fruits (5.83%). The line RIG-10 had the highest value of ascorbic acid (V.C) content and acidity in their fruits.

INTRODUCTION

Since the modern cultivars often have higher crop indices than the older outmoded ones (Holiday, 1976), attention must be given to the development of new high-yielding cultivars through breeding programes. The breeder hopes after crossing, he will find plants in the F_2 (or later generations) which combine the desired levels of expression. Maximum progress in improving a character would be expected with a carefully designed pedigree selection programme when the additive gene action is the main components of gene effects. Many studies reported that, the additive genetic variance were more important than non-additive ones for most tomato traits, among them Al-Falluji and Lambeth (1980); Shalaby et al. (1983); Omara et al. (1988); Metwally et al. (1990); Hatem (1994) and Zanata (2002). However, many investigators used selection or recommended use selection in breeding programes to obtain a new lines of tomato. For producing a new lines of tomatoes adapted to high temperature, Berry and Rafique Uddin (1988) selected F_3 and F_4 lines from different origin. For soluble solids, Stoner and Thompson (1989) reported that the selections in the F_2 for high and low soluble solids in tomato were effective

in changing the population mean. The high-yielding stable genotypes and possibility of improving tomato yield may be occur through obtaining pure lines by selection programme (El-Sharkawy et al., 1997 and Surjan Singh et al., 1999). Also, Amin et al. (2001) after obtaining large values of heritability, suggested the possibility of improving tomato traits through selection programes. The main objective of this study was to develope some new promising tomato lines by selection and evaluated the selected lines for some plant and fruit characteristics to choose the superior breed lines.

MATERIALS AND METHODS

This study was carried out at Kafr-Farses, Zifta district, Gharbia governorate, Middle-Delta Region during the successive seasons of 1997-2001. Seeds of 3 F_2 populations of tomato (Lycopersicon esculentum Mill) were obtained from the commercial F_1 hybrids Shady lady (Sun seed Co.). Golden Red (Vikima seed Co.) and Petopride (Peto seed Co.). In the early summer of 1998, 1000 plants from each F_2 population were grown. The best plants were selected (39 plants) and seeds were separately collected. In the late summer of 1998, 150 plants from the progeny of each selected plant were planted. Observations and selection were made between and within the F_3 families, in order to, choose the best plants with the best fruit characters. Ten families were excluded according to the preliminary observations, and seeds of the best plant from each remained family were separately collected as F_4 generation. Observations and selection were continued during early and late summer of 1999 to develop F_6 generation. In the early summer of 2000, the F_6 populations of the 29 selected genotypes in addition to. the line NC50-7 which procured from North Caroline State University U.S.A. were grown with the three check cultivars CastleRock, Super strain B and Peto 86. The coefficient of variance (C.V. %) was estimated for all studied genotypes concerning some characters, i.e., plant height, fruit length and diameter and fruit total soluble solids (T.S.S.%) to determine the degree of homogeneity in these genotypes. At the same time data for some plant and fruit characteristics were recorded. In the early summer of 2001, five populations were excluded due to their high heterogeneity and the remaining 25 genotypes were evaluated again. The seedlings of these genotypes were transplanted on February 5th and on June 20th in the early and late summer experiments, respectively. A randomized complete block design with three replicates was used in this study. each plot consisted of two rows; each row was 1 m wide and 6 m long and plants were set 40 cm apart. Routine cultural practices were done as needed similar to those used in tomato production.

Data were recorded on the following characters: ten plants per plot were randomly labelled in each plot and plant height (cm), main stem length (cm), number of branches and leaves per plant were recorded at the end of flowering stage for the ten plants and the means of studied characters were estimated. Early yield (kg/plant) as the yield of the first three pickings, total yield as total weight (kg/plant) of all harvested fruits. Average fruit weight (gm) was determined by dividing total fruit weight on the total fruit number. A random sample of five fruits per plot were used for measuring fruit length, diameter and number of locules. The measurements were recorded three times during the growing seasons and the means were estimated. Fruit shape was described according to UPOV Gudie (1992). Fruit firmness was measured using a needle type pocket penetrometer according to M. Monet-I.N.R.A. The percentage of total soluble solids (TSS%) content in the fruit juice was determined by hand refractometer. Ascorbic acid (V.C.) content was determined by titration with 2, 6-dichlorophenol-indophenol blue dye. Titratable acidity as citric acid percentage was determined by titration 0.1 N sodium hydroxide. Data were recorded during the two seasons of 2000 and 2001. Then, the combined data over the two seasons were calculated and statistically analyzed. Means were compared based on the L.S.D. test.

RESULTS AND DISCUSSION

A. Degree of homogeneity: Estimated coefficient of variance values C.V. % for plant height, fruit length, and diameter and fruit total soluble solids (T.S.S. %) percentage are presented in Table (1).

For plant height, the genotypes L. 54, S. 2, S. 65. G. 8, G. 16, RIG-10 and NC50-7 could be considered the highest homogeneous for plant height, since they gave the lowest variation within their plants. The obtained C.V. % values in these genotypes were less than 6.0%. On the other hand, the lowest homogeneity were observed in the lines S. 5 and S. 39, where, they gave the highest C.V. % values (15.41 and 16.11%, respectively). However, except the genotypes S. 5, S. 17 and S. 39, the bred new genotypes become high homogeneous for plant height, since the C.V. % values for these lines were close to or lower than those of the check cultivars.

Concerning fruit length, data listed in Table (1) showed that, the highest homogeneity was observed within plants of the genotypes S. 2, S. 30, S. 48, G. 4-2 and G. 5, since they gave the lowest C.V. % values (7.65, 7.10, 7.25, 7.67 and 7.21%, respectively). While, plants of the genotypes S. 5, S. 17, S. 39 and G., 3 showed the highest heterogeneity, where they gave the highest C.V. % values (20.32, 15.72, 19.52 and 22.13%, respectively). Except these previous four genotypes, the C.V. % values in the new breeding lines were lower than those of the check cultivars CastleRock and Super strain B.

Table 1: Estimates coefficient of variance (C.V.%) values for four studied characters in the studied new lines.

Genotypes	Plant height	Fruit length	Fruit diameter	T.S.S. %
L.54	5.12	8.13	10.32	11.10
S.2	4.80	7.65	6.74	9.62
S.5	15.41	20.32	10.42	13.75
S.15	6.15	9.17	8.62	10.12
S.17	8.50	15.72	14.35	17.86
S.19	7.14	8.21	9.51	9.32
S.30	6.3	7.10	11.06	8.06
S.39	16.11	19.52	13.61	15.11
S.48	7.52	7.25	10.42	12.75
S.60	6.13	8.62	7.74	11.17
S.65	5.82	8.17	8.57	9.76
S.76	7.20	10.12	8.17	12.11
S.80	6.19	9.28	7.92	10.23
S.102	8.12	10.20	9.42	11.31
S.106	6.30	8.57	10.42	10.06
S.114	8.12	11.40	14.32	15.82
S.125	6.05	8.67	10.05	9.05
G.3	7.40	22.13	15.32	18.65
G4-2	6.20	7.67	9.19	10.27
G.5	7.50	7.21	8.17	9.11
G.6	6.35	9.15	7.21	8.34
G.8	5.82	8.87	8.13	9.53
G.12	6.12	9.32	6.25	9.41
G.16	5.27	11.20	7.92	8.18
G.19	6.40	10.92	10.64	12.15
G.30	6.15	9.51	9.56	11.92
GR2-4	7.53	8.25	11.71	10.87
RIG-10	5.42	8.63	7.43	8.40
LB.2-1	6.11	9.34	7.04	11.67
NC50-7	5.72	8.14	10.52	12.82
Check cvs:				
CastleRock	7.41	14.75	11.46	13.62
Super strain B	8.12	15.21	12.53	14.31
Peto 86	6.49	10.53	8.11	10.55

Regarding fruit diameter, obtained data (Table 1) not greatly differed. Since, the breed genotypes, except S. 17, S. 39, S. 114 and G. 3 showed less C.V. % values than those recorded by the check cultivars CastleRock and super strain B, indicating that these new bred genotypes become high homogeneous in this trait. The highest homogeneity was observed within plant of the genotypes S. 2, S. 60, S. 80, G. 6, G. 12, G. 16, RIG-10 and L.B.2-1, where they gave the lowest C.V. % values (less than 8.0%) compared with check cultivar Peto 86.

In respect of fruit total soluble solids (T.S.S. %) content. the coefficient of variance values in the bred genotypes (Table 1) reflected the homogeneity within plants of these genotypes. Since, except the genotypes S. 5, S. 17, S. 114 and G. 3, the remaining ones showed C.V. % values less than those of CastleRock and Super strain B check cvs. The lowest C.V. % values, i.e., 8.06, 8.34, 8.18 and 8.40 were recorded for the genotypes S. 30, G. 6, G. 16 and RIG-10, respectively, indicating that they were more phenotipically uniform than other genotypes.

Generally, the degree of homogeneity (C.V.%) varied from genotype to another in the same character, and from trait to others in the same genotype. Nearly, the breeding genotypes , except S. 5, S. 17, S. 39, S. 114 and G. 3 became high homogeneous compared with the check cultivars CastleRock and Super strain B which are widely grown in Egypt. Consequently, the lines S. 5, S. 17, S. 39, S. 114 and G. 3 were excluded and the remaining breed genotypes showed enough homogeneous, and could be considered new lines.

B. Means value of the resulted breed lines: Highly significant differences among the lines studied were observed for all studied traits. (Table 2 and 3).

For plant height, data recorded in Table (2) showed that the breed lines showed average plant height ranged from 48.7 to 75.1 cm with a mean of 61.1 cm. The plants of the lines S. 15, S. 65 and G. 30 showed the maximum height (72.6, 75.1 and 70.2, respectively), while the shortest plants were found in the line S. 125 (48.7 cm). Majority of the lines (48%) had plant height between 60-70 cm., while a proportion of 36% from the lines gave plants with height between 50-60 cm. (Fig. 1). Comparisons of the lines studied with the check cvs. showed that, 40% from them had plants significantly taller than the check cultivar Peto 86 (the tallest check). The percentages of increase were ranged from 19.5% (in the line G 4-2) to 43.6% (in the line S. 65).

The lines showed main stem length values ranging from 44.7 to 67.5 with a mean of 55.5 cm. The lines S. 102, S. 106, G. 16 and GR 2-4 produced the longest stem (67.3, 67.5, 63.8 and 62.3 cm., respectively), while the shortest stem (46.6 and 44.7 cm) were recorded by the lines S. 125 and G. 8, respectively (Table 2). However, large proportion of the lines (48%) produced plants with main stem longer than that of the check cultivar Super strain B by a percentages ranging from 21% (in the line G. 30) to 40% (in the line S. 106).

The highest number of branches per plant, i.e., 7.8, 7.6, 7.5 and 7.9, were recorded by the lines S. 48, S. 65, S. 102 and G. 30, respectively, while

Table (2): Means value of the studied lines for some plant characters (combined data of 2000 & 2001 seasons).

Genotypes	Plant height (cm)	Main stem length (cm)	No. of branches	No. of leaves	Early yield (kg/pl.)	Total yield (kg/pl.)	Av. fruit weight (g)
L.54	67.2	58.4	6.4	76.3	0.945	5.840	196.83
S.2	61.5	52.6	6.7	56.7	1.688	4.980	103.04
S.15	72.6	59.5	7.0	78.7	1.564	5.986	191.06
S.19	62.0	51.8	6.3	54.0	1.338	4.960	161.72
S.30	58.3	60.0	4.8	54.1	1.503	5.543	180.73
S.48	61.7	51.2	7.8	119.6	1.382	5.436	189.61
S.60	53.2	46.8	7.2	62.2	1.043	5.660	186.61
S.65	75.1	61.6	7.6	95.3	1.414	6.785	188.14
S.76	51.4	48.9	6.0	62.5	1.243	4.751	150.02
S.80	52.5	48.0	7.0	75.6	1.368	6.873	220.65
S.102	54.3	67.3	7.5	71.8	1.427	5.823	212.10
S.106	62.8	67.5	7.4	93.6	1.220	5.442	270.32
S.125	48.7	46.6	4.7	41.7	0.800	4.455	178.20
G4-2	62.5	61.2	6.6	72.3	0.190	6.833	232.67
G.5	55.2	58.5	6.3	89.3	0.907	4.692	130.33
G.6	60.3	48.1	6.8	56.0	1.135	5.663	149.30
G.8	51.7	44.7	5.0	51.5	1.362	5.847	152.43
G.12	66.7	51.0	6.2	64.0	1.020	5.407	157.50
G.16	68.4	63.8	7.0	65.6	1.125	6.850	166.12
G.19	62.1	51.7	6.1	69.9	0.263	5.123	158.20
G.30	70.2	58.3	7.9	68.3	0.390	7.075	125.68
GR2-4	68.6	62.3	6.7	73.3	0.170	6.823	210.09
RIG-10	58.9	52.9	7.1	72.3	1.925	4.775	93.67
LB.2-1	65.3	55.2	7.0	53.0	1.067	4.566	91.06
NC50-7	57.4	60.1	6.8	70.2	1.177	5.458	186.09
Means	61.1	55.5	6.6	70.7	1.106	5.658	171.29
Check cvs.							
CastleRock	48.5	43.0	5.7	49.5	1.877	3.683	92.08
Super strain B	50.8	48.2	6.0	54.3	1.802	3.575	90.90
Peto 86	52.3	45.1	6.3	44.8	1.905	4.192	73.43
L.S.D. 5%	10.13	8.14	1.14	6.58	0.135	0.420	20.58
L.S.D. 1%	12.21	10.82	1.52	9.41	0.180	0.675	25.37

the lowest values (4.8, 4.7 and 5.0) were obtained by the lines S. 30. S. 125 and G. 8, respectively. The studied breed lines showed number of branches per plant ranged from 4.7 to 7.9 with a mean of 6.6 branch plant (Table 2). However, a large proportion of the entries (60%) produced 5-6 branch/plant, while 28% of them gave plants with branch numbers more than 7 branch per plant (Fig. 2). Also, 20% from the line showed plants with branch numbers larger than that of recorded in the check cultivar Peto 86 (the highest checks).

Table (3): Means value of the studied lines for some fruit characters (combined data of 2000 & 2001 seasons)..

Genotypes	Fruit length (cm)	Fruit diameter (cm)	Fruit shape	Fruit firmness	No of locules	TSS %	V.C.	Acidity %
L.54	6.6	6.9	Round	401.4	5.7	5.17	25.40	0.397
S.2	8.2	5.1	Cylindrical	392.5	3.0	5.00	21.13	0.426
S.15	6.4	6.5	Round	472.6	7.0	5.67	22.73	0.388
S.19	5.8	6.1	Round	397.1	5.4	5.17	25.00	0.393
S.30	6.2	6.3	Round	402.7	5.2	5.21	27.60	0.405
S.48	6.4	6.1	Round	403.5	6.0	5.70	24.53	0.407
S.60	7.8	6.5	Cylindrical round	462.3	6.3	5.08	29.37	0.416
S.65	6.5	6.8	Round	461.8	6.9	5.67	28.43	0.412
S.76	5.8	6.7	Round	403.6	5.8	5.18	32.43	0.398
S.80	8.5	6.8	Cylindrical round	453.0	6.4	5.31	20.53	0.409
S.102	8.6	7.8	Round	397.5	7.2	5.58	31.17	0.401
S.106	9.3	8.1	Cylindrical round	425.3	7.3	5.83	22.33	0.410
S.125	8.1	6.3	Obovoid	407.3	5.0	5.08	24.93	0.393
G4-2	8.2	7.2	Round	623.8	6.8	3.02	18.80	0.350
G.5	5.6	5.1	Round	501.7	4.3	5.17	20.62	0.403
G.6	6.4	5.3	Obovoid	526.7	4.5	4.92	28.73	0.412
G.8	8.5	6.1	Obovoid	557.7	4.1	5.00	28.27	0.425
G.12	8.3	6.5	Obovoid	566.3	4.6	5.08	30.70	0.401
G.16	8.1	6.2	Obovoid	556.8	4.3	5.20	29.90	0.426
G.19	7.0	6.4	Round	741.7	5.7	2.92	18.32	0.382
G.30	6.2	5.3	Round	721.9	5.0	3.21	20.92	0.394
GR2-4	8.4	7.1	Round	738.6	6.6	3.01	18.50	0.356
RIG-10	7.6	5.3	Ovoid	595.0	3.0	5.10	33.87	0.428
LB.2-1	12.1	3.5	Long-datey	383.1	2.3	5.25	26.73	0.412
NC50-7	5.7	6.8	Round	433.3	6.2	4.83	29.27	0.407
Mean	7.5	6.4		504.2	5.3	4.89	25.61	0.403
Check cvs:								
CastleRock	6.1	5.80	Round	585.6	4.1	4.42	31.80	0.401
Super strain B	5.8	4.6	Round	616.3	3.4	4.50	28.17	0.415
Peto 86	5.4	4.1	Ovoid	630.7	2.3	4.62	30.73	0.422
L.S.D. 5%	1.24	0.90		32.4	0.94	0.58	4.62	0.065
L.S.D. 1%	1.62	1.25		41.6	1.25	0.80	6.01	0.090

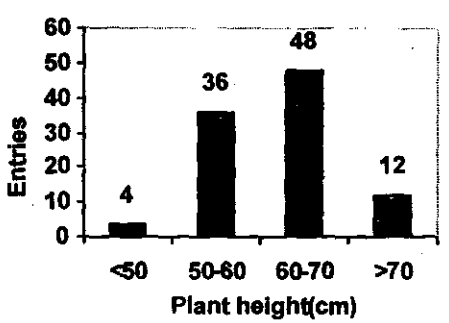

Fig. (1)

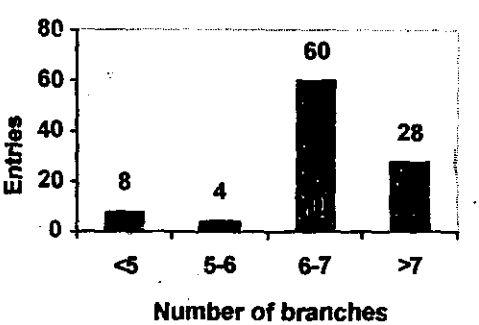

Fig. (2)

For number of leaves per plant, there were great variations among the studied lines (Table 2), since they produced number of leaves per plant ranging from 41.7 to 119.6 with a mean of 70.7 leaf/plant. The maximum number of leaves pert plant (98.7, 119.6, 93.3 and 93.6) was recorded by the lines S. 15, S. 48, S. 65 and S. 106, respectively, while the minimum number of leaves/plant (41.7 and 51.5) was given by plants of the lines S. 125 and G. 8, respectively. Also, a large proportion of the entries (72%) produced plants with leaf numbers per plant higher than those of the check cultivar Super strain b (the highest checks). In this respect, the percentages of increase were ranged from 14.5% (in the line S. 60) to 120.3% (in the line S. 48).

Generally, we can see that, the breed lines S. 15, S. 65, S. 102 and S. 106 showed vigorous growth, since they recorded high values for plant height, main stem length and number of branches and leaves per plant and may be used as materials for vigorous growth in the hybridizations. These results regarding the previous vegetative growth traits were in agreement with the previous studies of Mahasen and Hewedy (1994), for plant height, and Zanata (2002) for number of branches per plant. since their results revealed significant differences in these traits among lines and cultivars studied.

For early yield (weight of fruits/plant), the lines produced early yield ranged from 0.170 to 1.925 with a mean of 1.106 kg/plant (Table 2). The highest early yield (1.925 kg/plant) was produced by the line RIG-10 followed by the line S. 2 which produced early yield of 1.688 kg/plant. On the other hand, the lowest early yields (0.190 and 0.170 kg/plant) were produced by the lines G 4-2 and GR 2-4, respectively. The early yield distribution of 25 studied lines is given in Fig. (3). Among the entries, 28, 32, 24 and 16% of them produced early yields of < 1.0, 1.0-1.250, 1.250-1.500 and > 1.500 kg/plant. However, only the line RIG-10 produced early yield approximately similar to those of Peto 86 (the highest checks).

Highly significant differences among the evaluated breeding lines were observed in total yield (kg/plant), since their yields ranged from 4.455 to 7.075 with a mean of 5.658 kg/plant (Table 2). The highest total yield (more than 6.0 kg/plant) was produced by the lines S. 65, S. 80, G. 4-2, G. 16, G. 30 and GR. 2-4, while the least yield values (4.455 and 4.566 kg/plant) were observed by the lines S. 125 and L.B. 2-1, respectively. The yield distribution of 25 studied lines is given in Fig. (4). From this figure, a proportions of 28, 20, 32 and 20% from the breed lines produced total yield of < 5.00, 5.00-5.500, 5.50-6.00 and > 6.00 kg/plant, respectively. However, a large proportion of the bred lines (92%) significantly outyielded the check

cultivar Peto 86 (the highest checks). The percentages of increase were ranged from 11.9% (in the line L. 54) to 68.8% (in the line G. 30). Then it could be concluded that, most of these lines are very good compared with the check cvs. used and recommended as new lines. These results are agreement with Shalaby et al. (1983), Radwan et al. (1986), Berry et al. (1988), Mahasen and Hewedy (1994), Hassan et al. (2000) and Zanata (2002), who found significant differences for early and total yield among tomato lines and cultivars studied.

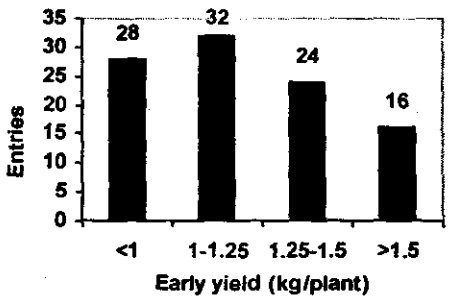

Fig. (3)

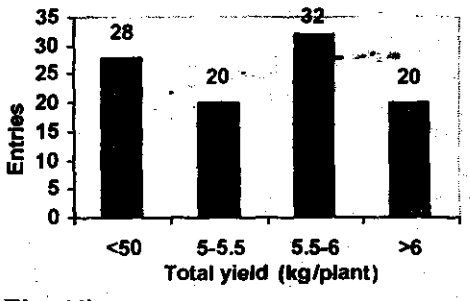

Fig. (4)

Average fruit weight was ranged from 91.06 to 270.32 with a mean of 171.29 gm (Table 2). The heaviest fruits were obtained by the lines S. 80. S. 102, S. 106, G 4-2. and GR 2-4. They, respectively, produced fruits with weight of 220.65. 212.10. 270.32, 232.67 and 210.09. On the other hand. the lightest fruits were recorded in the lines RIG-10 and L.B.2-3 (93.67 and 91.06 gm, respectively). A large proportion of the breed lines (56%) produced fruits with average weight between 150-200 gm. While. a percentage of 20% from the lines produced fruits with average weight more than 200 gm (Fig. 5). However, all the resulted breed lines, except S. 2, RIG-10 and L.B.2-1, significantly surpassed the check cultivar CastleRock (the highest check). The percentages of increase were ranged from 36.9% (in the line G. 30) to 193.6% (in the line S. 106).

Regarding fruit length, diameter, shape and locule number, obtained data (Table 3) showed significant differences among the lines studied in these traits. The studied lines produced fruits with dimensions ranged from 5.6 to 12.1 cm in length, and from 3.5 to 8.1 cm, in diameter. The line L.B.2-1 showed the longest and thinnest fruits (12.1 and 3.5 cm, respectively). This line produced long-datey fruits, and have the least mean locule number value per fruit (2.3). The lines S.102 and S.106 produced fruits with high length and diameter values. Fruit shape in these two lines were round and cylinderical-round, respectively. These two lines had the largest mean locule number in their fruits (7.2 and 7.3, repectively). The

lines S.125, G.6, G.8, G.12 and G.16 produced obovoid fruits, since they have long fruits with moderate diameter (8.1 vs. 6.3, 6.4 vs 5.3, 8.5 vs 6.1, 8.3 vs 6.5 and 8.1 vs 6.2 cm, respectively). The average locule number per fruit in these lines ranged from 3 to 4.6.

For fruit firmness, the lines G4-2, G.19, G.30, GR2-4 produced the firmest fruits followed by the lines S.2, G.5, G.6, G.8, G.12, G.16 and RIG.10. They recorded mean values ranged from 501.7 g/cm^2 (in the line G.5) to 741.7 g/cm^2 (in the line G.19). On the other hand, the least fruit firmness values (397.1, 397.3 and 383.1 g/cm^2) were noted in the lines S.19, S.102 and LB2-1, respectively. Compared with the check cultivar CastleRock, fruits of the lines G4-2, G-19, G.30 and GR2-4 were high firmness, while the lines S.2, G.8, G.12, G.16 and RIQ-10 produced fruits with average firmness values approximately similar to this check cv. Although large number of the lines (16) produced fruits with low firmness values compared with the check cultivar CastleRock, fruit firmness in some of these lines (which showed values between 450-550 g/cm^2) was accepted compared with fruit weight which was large in these lines.

These results were in agreement with those of Shalaby et al. (1983) and Omara et al. (1988), for average fruit weight; Mahasen and Hewedy (1994), for weight, length, diameter, locule number and firmness of the fruits; Hassan et al. (2000) and Zanata (20002) for average fruit weight and firmness, who found significant differences among lines and cultivars studied for these traits.

Total soluble solids (T.S.S.%) values in tomato fruits of breed lines studied were ranged from 2.92 to 5.83 with a mean of 4.89 (Table 3). Fruits of the lines S.15, S.48, S.65, S.102 and S.106 contained the highest TSS% values, i.e., 5.67, 5.70, 5.67, 5.58 and 5.83%, respectively. While, the lines G4-2, G-19, G-30 and GR2-4 contained the lowest percentage of TSS% values in their fruits (3.02, 2.92, 3.21 and 3.01, respectively). The TSS% distribution of 25 lines (Fig. 6) showed that a large proportion of the entries (76%) had TSS% content values more than 5%, while all the check cvs recorded TSS% values less than 5%.

The breed lines contained ascorbic acid (V.C) content in their fruit ranged from 18.5 to 33.87 with a mean of 25.61 mg/100 g, fresh weight of fruits. The highest values of vitamin C content (32.43, 31.17, 30.70 and 33.87 mg/100 g fruits), respectively, were reflected by the lines S.76, S.102, G.12 and RIG-10. Meanwhile, the lowest content of vitamin C was given by the lines G4-2, G-19 and GR2-4, respectively, since they showed 18.80, 18.32 and 18.5 mg/100 g fruits. Also, from the studied lines, 11 and 15 ones were statistically similar to CastleRock and Super strain B check cvs, respectively.

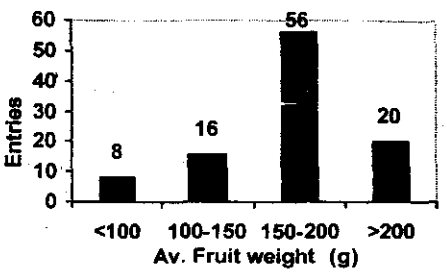

Fig. (5)

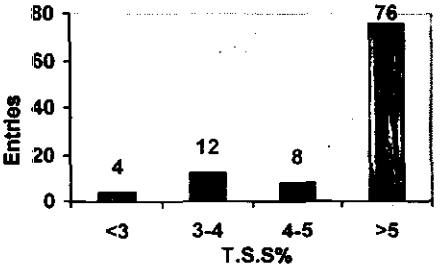

Fig. (6)

For fruit acidity as citric acid percentage values (Table 3), the lines S.2, G.8, G.16 and RIG-10 had the highest fruit values (0.426, 0.425, 0.426 and 0.428, respectively). On the other hand, the lowest values of acidity (0.350 and 0.356), respectively, were given by the lines G.4-2 and GR2-4. However, fruit acidity values in the studied lines ranged from 0.350 to 0.428 with a mean of 0.403, indicating significant differences among these lines studied.

These results are confirmed with those of Berry et al. (1988), for fruit T.S.S.% and acidity; Stoner and Thompson (1989) and Mahasen and Hewedy (1994) for TSS% content and Hassan et al. (2000) for vitamin C content and fruit acidity, who reported significant differences for these traits among lines and cultivars studied.

During this selection programme, the lines G4-2, G.19, G.30 and GR2-4 were appeared in the F2 generation. Fruits of these lines were late maturity, since the formation and development of these fruits were slowly occur. The rip fruits in these lines were yellow colour and had high firmness but low TSS% and vitamin C content values. Also, fruits of these lines had long shelf life for many months. According to studies of Buescher et al. (1981) and Kopeliovitch et al. (1982), these lines involved the non-ripening mutation and the recessive gene "nor nor" that is responsible for appearing of this mutation.

In conclusion, this investigation revealed that selection from F_2 populations is effective method to improve characters and develop high-yielding lines of tomato. Then, these new breeding lines could be used for commercial production as a new tomato cultivars or could be used to obtain high yielding hybrids of tomato.

REFERENCES

Al-Falluji, R.A. and V.N. Lambeth (1980). Inheritance of pericarp tissue firmness in tomato. HortSci. 15: 422-423.

Amin, El. S.A.; M.M. Abd El-Maksoud and Aida, M. Abd El-Rahim (2001). Genetical studies on F_1 hybrids, F_2 generations, and genetic parameters associated with it in tomato (*Lycopersicon esculentum* Mill). J. Agric. Sci. Mansoura Univ., 26(6): 3667-3675.

Berry, S.Z. and M. Rafique Uddin (1988). Effect of high temperature on fruit set in tomato cultivars and selected germplasm. HortSci. 23(3); 606-608.

Berry, S.Z.; M. Rafique Uddin; W.A. Gould; A.D. Bisges and G.D. Dyer (1988). Stability in fruit yield, soluble solids and citric acid of eight machine-harvested processing tomato cultivars in northern Ohio. J. Amer. Soc. Hort. Sci. 113(4): 604-608.

Buescher, R.W.; C. Hardy and E.C. Tigchelaar (1981). Post-harvest color development in nor F_1 tomato hybrids as influenced by maturity state at harvest. HortSci. 16: 329-330.

El-Sharkawy El-S.M.S.; Aida, M. Abd El-Rahim and M.A. Ahmed (1997). The importance of genetic parameters and correlation coefficient for economical traits of tomato (*Lycopersicon esculentum* Mill). J. Agric. Sci., Mansoura Univ., 22(9): 2845-2855.

Hassan, A.A.; S.E.S. Moustafa; K.E.A. Abdel-Ati and A.A. Mohamed (2000). Development and release of some new tomato hybrids. I. Parental evaluation, hybrid yield performance and yield heterosis. Egypt. J. Hort. 27(2): 201-218.

Hatem, M.K. (1994). Heterosis and nature of gene action in tomato. M.Sc. Thesis, Fac. Agric., Minufiya Univ., Egypt.

Holiday, R. (1976). The efficiency of solar energy conversion by the whole crop. Food Prod. and Cons., pp. 127-146.

Kopeliovitch, E.; Y. Mizrahi; H.D. Rabinowitch and N. Kedar (1982). Effect of the fruit-ripening mutant genes rin and nor on the flavor of tomato fruit. J. Amer. Soc. Hort. Sci., 107: 361-362.

Mahasen, A.H. Mohamed and A.R. Hewedy (1994). Assessment of response of some tomato determinate cultivars to high temperature. Egypt. J. Hort. 21(2): 1-25.

Metwally, E.I.; G. El-Fadly and A.Y. Mazrouh (1990). Inheritance of yield and fruit quality of some tomato crosses grown under heat stress conditions in Egypt. J. Agric. Res., Tanta Univ., 16: 517-527.

Omara, M.K.; S.E.A. Younis; Tahany, H.I. Sherif; M.Y. Hussein and H.M. El-Aref (1988). A genetic analysis of yield and yield components in the tomato (*Lycopersicon esculentum* Mill). Assiut J. Agric. Sci. 19(1): 227-238.

Radwan, A.A.; A.A. Hassan and M.A.M. Ibrahim (1986). Tomato cultivar evaluation for high temperature tolerance. Egypt J. Hort. 13(2): 145-151.

Shalaby, G.I.; M.K. Iman; A. Nassar; E.A. Waly and M.F. Mohamed (1983). Studies on combining ability of some tomato cultivars under high temperature conditions. II. Fruit and yield characters. Assiut J. Agric. Sci. 14(1): 47-56.

Stoner, A.K. and A.E. Thompson (1989). The potential for selecting and breeding for solids content of tomatoes. Amer. Soc. Hort. Sci. 89: 505-511.

Surjan-Singh; M.S. Dhaliwal; D.S. Cheema; G.S. Brar and S. Singh (1999). Breeding tomato for high productivity. Hort.Sci. 13(3): 95-98.

UPOV (1992). International union for the protection of new varieties of plant. UPOV Gudi line of tomato TG/44/7.1-56, p. 21.

Zanata, O.A. (2002). Heterosis in tomato (*Lycopersicon esculentum* Mill) and possibilities of producing F_1 hybrids for commercial. Ph.D. Thesis, Fac. Agric., Mansoura Univ., Egypt.

الملخص العربى

انتاج سلالات عالية المحصول من الطماطم بواسطة الانتخاب

أحمد محمود قنصوه

قسم بحوث الخضر ــ معهد بحوث البساتين ــ مركز البحوث الزراعية بالجيزة ــ مصر

أجريت هذه الدراسة بمركز زفتى ــ غربية ــ اقليم وسط الدلتا خلال الفترة من ١٩٩٧ الى ٢٠٠١ وذلك لانتاج سلالات من الطماطم عالية الانتاجية. حيث تم الحصول على بذور ٣ عشائر للجيل الثانى لثلاث هجن جيل أول تجارية. تم استخدام برنامج الإنتخاب مع تسجيل النسب حتى الجيل السادس حيث تم الانتخاب بين السلالات لاحسنها وداخل السلالات لاحسن النباتات وفى كل مرة يتم جمع البذور الناتجة من كل نبات على حدة. فى الجيل السادس تم تقدير التباين داخل السلالات لعدد من الصفات (طول النبات ، طول وقطر الثمرة ، المواد الصلبة الذائبة الكلية) لحساب درجة التجانس داخل السلالات عن طريق معامل الاختلاف والذى اظهرت حساباته وجود تماثل بين ٢٤ سلالة حيث تم الاعتماد عليها واستبعاد السلالات الاخرى التى بها عدم تماثل مقارنة بالاصناف التجارية وهى كاسل روك ــ سوبر استرين بى ــ بيتو ٨٦.

أظهرت نتائج تقييم هذه السلالات وجود اختلافات معنوية بين السلالات فى كل الصفات النباتية والثمرية المدروسة. أعطت السلالات S.15 ، S.65 ، S.102، S.106 أعلى قوة نمو للمجموع الخضرى حيث أعطت هذه السلالات أعلى قيم لطول النبات و عدد الفروع والاوراق على النبات وطول الساق الرئيسى للنبات.

أنتجت السلالة RIG.10 أعلى محصول مبكر حيث بلغ ١,٩ كجم/نبات بينما تفوقت السلالات الخمسة S.65 ، S.80 ، G.4-2 ، G.16 ، G.30 فى محصولها الكلى على كل السلالات وزادت بنسبة أكبر من ٦٠% على الاصناف الثلاثة التجارية كاسل روك ، سوبر استرين بى ، بيتو ٨٦. معظم السلالات انتجت ثمار تفوقت فى متوسط وزن الثمرة عن الاصناف الثلاثة المقارنة.

ظهرت خلال برنامج الانتخاب بعض السلالات التى بها الجين المسئول عن طفرة عدم النضج فى الثمار و أعطت السلالات G4-2 ، G-30 ، GR2-4 التى بها هذه الطفرة اعلى صلابة فى الثمار. أعطت السلالة S.106 اعلى قيمة للمواد الصلبة الذائبة الكلية فى الثمار بينما أعطت السلالة RIG-10 أعلى قيم لفيتامين C والحموضة فى الثمار واختلف شكل الثمار فى السلالات من المستديرة الى البلحية الطويلة.